PART I OVERVIEW

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CHAPTER 1 INTRUDUCTION

1-1 Objectives

The objective of this project is to discover new ore deposits through clarification of the geologic conditions and mineralization of the survey area. This project will be carried out during the three-year period of fiscal 1998 to 2000. This is the second year of this project.

1-2 Conclusions and Recommendations of the First-Phase Survey

1-2-1 Conclusions of the first-phase survey

Analyses and interpretation of existing data, photogeological interpretation, surface geological survey, and IP geophysical survey (henceforth IP survey) were carried out in the Umm ad Damar area as the first-phase of this project and the following conclusions were obtained.

① The geology of the survey area consists mainly of; lavas and pyroclastic rocks of Late Proterozoic rhyodacite, andesite, dacite, and jasper belonging to the Arj Group. This group is intruded by diorite, quartz diorite, tonalite, andesite, dacite, rhyodacite and basalt bodies. These units are covered unconformably by Late Proterozoic andesitic lava and pyroclastic rocks of the Mahd Group in the western edge of the survey area.

② Three known prospects, namely Umm ad Damar North Prospect, Umm ad Damar South Prospect, and 4/6 Gossan Prospect occur in the survey area (henceforth the North Prospect, the South Prospect, and the 4/6 Gossan). The mineralized zones of these prospects are products of dissemination to network copper hydrothermal activity, and the zone of the 4/6 Gossan has particularly high Au, Ag, Pb, Zn grade. The existence of seven mineralized zones are inferred in these prospects. They are; five (Nos.1—5) in the North Prospect, one in the South Prospect, and one in the 4/6 Gossan.

③ In the past, geological survey, IP survey, trenching, and drilling have been carried out for these prospects. Sufficient exploratory work has not been carried out, however, for the lower part and extensions of the mineralized zones. Also the area covered by sand and gravel, which constitutes 60% of the survey area, has not been explored sufficiently.

④ It is concluded from integrated study of the results of the past drilling exploration and the first-phase detailed geological survey, that the following zones warrant further exploration; namely under the slag in the North Prospect, western extension of the mineralized zone of the South Prospect, and the lower and southern parts of the mineralized zone of the 4/6 Gossan.

⑤ Strong chargeability anomalous zones exceeding 24 mV/V were extracted at the following four localities by IP survey. These zones are at; Jabal Sujarah ("B-12" anomalous zone), southeastern extension of No.3 Mineralized Zone of the North Prospect ("J-25"), intermediate point between the North and South Prospects ("M-27"), and western edge of the South Prospect ("P-18").

⑥ Carbonatization is strong near "B-12" which is located at the intersection of NE-SW and NW-SE faults. Also "B-12" is geologically similar to the Jabal Sayid deposit by the occurrence of jasper, rhyodacite, and other factors. "J-25" is located between NW-SE trending No.3 and No.4 mineralized zones of the North Prospect. "M-27" and "P-18" occur near a NE-SW trending fault, and an oxidized copper-bearing quartz vein and ancient pits are distributed near "M-27". The above four anomalous zones have high resistivity, and it is concluded from various aspects including laboratory tests that the high chargeability anomalies are reflection of the sulfide bodies in the deeper parts.

1-2-2 Recommendations for the second-phase survey

Drilling exploration in the following zones is considered to be desirable.

North Prospect: Most of the No.2 Mineralized Zone is covered by slag and thus this zone is not well known. Drilling is recommended in this zone for detailed assessment. "J-25" zone is located between the No.3 Mineralized Zone of the Southeast Hill and the No.4 Mineralized Zone of the Southeast Extension and drilling aimed at the lower part of this zone is concluded to be necessary.

4/6 Gossan: This chargeability anomalous zone is relatively small, and thus strong and large scale mineralization cannot be anticipated, but the mineralization of this prospect is rich in Au and Ag. It is deemed worthwhile to clarify the mineral potential of this prospect by drilling in the deeper parts of the mineralized zone and in sites south of UAD-13.

Detailed geophysical surveys in the following zones are considered to be desirable.

"B-12" anomalous zone: This is the largest anomalous zone in the survey area. The elongation and the center of this zone could not be clarified because the IP line interval was large at 300m. Thus drilling cannot be immediately undertaken. IP survey with line interval of about 100m and TEM geophysical survey (henceforth TEM survey) will be the next step of exploration in this zone.

Area including "M-27" and "P-18" anomalous zones: These anomalous zones are inferred to indicate the existence of mineralized zone along the weak line with NE-SW strike, or "P-18" anomalous zone might be the western extension of the mineralized zone of the South Prospect. It is recommended to clarify the continuity and the center of the anomaly by IP survey with about 100m-line interval and TEM survey.

1-3 Outline of the Second-Phase Survey

1-3-1 Survey area

The survey area is located in the western part of Saudi Arabia. The areal extent of the survey area is 18 km^2 (Fig. 1-1).

1-3-2 Contents of the survey

(1) Drilling exploration

The objective of drilling is to confirm the state of deep mineralization in the promissing areas extracted from the results of first-phase regional geological survey, detailed geological survey of the North Prospect and the 4/6 Gossan, and regional IP survey with 300m-line interval.

(2) Detailed geological survey

Five sub-areas where TEM survey was carried out are located on flat areas, and are covered by Quaternary sands and gravels. Sufficient exploratory drilling has not been carried out for these sub-areas. The objective of detailed geological survey is to obtain geological data and mineralization data which are necessary for interpretation of the results of the second-phase geophysical surveys.

(3) IP survey

The objective of detailed IP survey with 100m-line interval is to clarify the continuity and the center of large-scale chargeability anomalies which were detected by the first-phase IP survey.

(4) TEM survey

Based on the chargeability distribution map obtained from the detailed IP survey, TEM survey will be carried out in the central parts. The objective of TEM survey is to estimate the localities and shapes of mineralized zones.

1-3-3 Exploration work

The work of the second-phase survey consisted of detailed geological survey, drilling exploration, detailed IP survey with 100m-line interval, and TEM survey. The amounts of these works are shown in Table 1-1.

Table 1-1 Amount of Work

Survey Method	Amount				
Geological Survey					
	Area Extent				6 km^2
	Laboratory Works				
	Microscopic Observation (Rock)				13 samples
	Micro. Observ. (Ore from Old Core)				8 samples
	Micro. Observ. (Ore from Outcrop)				2 samples
	X-ray Diffraction Analysis (Old Core)				2 samples
	X-ray Diffraction Analysis (Outcrop)				8 samples
	Ore Assay (Au,Ag,Cu,Pb,Zn,S-Old Core)				5 samples
	Ore Assay (Au,Ag,Cu,Pb,Zn,Fe-Outcrop)				8 samples
Drilling Exploration					
	Number of Drill Holes				8 holes
	Total Drilling Length				2,152.05 m
	Drill Hole	Area	Direction	Inclination	Drilling Length
	MJSU-1	4/6Gossan	245°	-55°	251.60 m
	MJSU-2	4/6Gossan	245°	-55°	250.00 m
	MJSU-3	UAD North	225°	-55°	250.00 m
	MJSU-4	UAD North	260°	-55°	304.25 m
	MJSU-5	UAD North	260°	-55°	346.20 m
	MJSU-6	4/6Gossan	245°	-55°	250.00 m
	MJSU-7	4/6Gossan	245°	-55°	250.00 m
	MJSU-8	Jabal Sujarah	25°	-70°	250.00 m
	Laboratory Works				
	Microscopic Observation (Rock)				73 samples
	Microscopic Observation (Ore)				27 samples
	X-ray Diffraction Analysis				28 samples
	Ore Assay (Au,Ag,Cu,Pb,Zn,S)				419 samples
Geophysical Survey IP Method					
	Length of Survey Lines				10.0 km
	Number of Stations				260 points
	Laboratory Works				
	Measurement of Rock Resistivity and Chargeability			Core	28 samples
				Outcrop	6 samples
TEM Method					
	Number of Stations				319 points

1-3-4 Survey team and survey duration

(1) Survey team

Field Supervisor

Hiroshi SHIBASAKI (Technical Cooperation Division, MMAJ)

Survey Team

1) Japanese side (Nikko Exploration and Development Co., Ltd.)

Yoshihiro KIKUCHI:	Team leader, Drilling exploration, Detailed geological survey
Toshihisa ISHIBASHI:	Geophysical survey
Saburo TACHIKAWA:	Geophysical survey
Mitsuyoshi SAITO:	Geophysical survey

2) Saudi Arabian side (DMMR)

Ghazi ABDULHAY:	Team leader, Coordinator
Mohamad SAHL:	Drilling exploration
Abudullah AL-JOHANI:	Drilling exploration
Ghazi KATTU:	Drilling exploration
Ahmad ZAMZAME:	Geophysical survey

(2) Duration

Field supervision: 26 February, 2000 to 28 February, 2000 (Hiroshi SHIBASAKI)

Field survey (at the survey area)

Drilling Exploration: 5 September, 1999 to 18 November, 1999

Detailed Geological Survey, IP survey and TEM survey:

25 January, 2000 to 28 February, 2000

Laboratory work and report preparation:

26 November, 1999 to 20 January, 2000

8 March, 2000 to 24 March, 2000

CHAPTER 2 GEOGRAPHY OF THE SURVEY AREA

2-1 Location and Access

The survey area is located about 300-km northeast of Jeddah. DMMR camp near the Jabal Sayid deposit was used as the base camp (shown in Fig. 1-1). This is located about 20-km northwest from the survey area. The survey area is about 30-minute drive from the base camp.

2-2 Topography and Drainage

The topography of the region including the survey area consists, from the west; the Red Sea, coastal plain of the Red Sea – hilly zone, the Hijaz Mountains, Harat Rahat (basalt plateau), sabkha zone, and low-relief mountainous zone. And the survey area is located at the easternmost part with low-relief mountains. The altitude gradually increases eastward from the Red Sea, the Hijaz Mountains are 1,200—2,300 m high, the highest part of the Harat Rahat is 1,500 m, the altitude of the sabkha zone and the low-relief mountains are 1,000—1,200 m.

The low-relief mountains including the survey area are a part of the Najd Plateau located to the east of the Hijaz Mountains. The topography of the survey area consists of flat zone with altitude of about 900 m with hills and small mountains ranging in relative height from 50 m to 100 m.

Hills and mountains in the survey area generally are elongated in the N-S and NW-SE directions, and those in the southeastern part of the survey area are elongated in the NE-SW direction.

In the survey area, permanent river does not exit. Wadis in the survey area become to be low toward north or northwestern direction, and join with the Wadi al Arj at an area northwest of the survey area.

2-3 Climate and Vegetation

Saudi Arabia is located at the central part of the great tropical desert, which extends from northern Africa to Asia. In the highlands, the day time temperature exceeds 40 ° C , but it often

drops to near 0 ° C at night in winter. The average annual precipitation at Mahd ad Dhahab is 62 mm.

Vegetation is sparse in the survey area with only acacia growing along wadis.

CHAPTER 3 GEOLOGY AND MINERALIZATION OF THE SURVEY AREA

3-1 Regional Geology and Mineralization

3-1-1 Regional geology

Based on Kemp et al. (1982), the geology of the area including the survey area, Jabal Sayid deposit and Mahd adh Dhahab mine (the above area will be called "this area" in this section) will be reported below (Fig. 1-2).

The Late Proterozoic Arj Group, Mahd Group, and Ghamr Group, in ascending order, occur in this area. These units are intruded by Dhukur Tonalite, Fufayriyah Tonalite, Bari Granodiorite, and granites of the Raghiyah Suite.

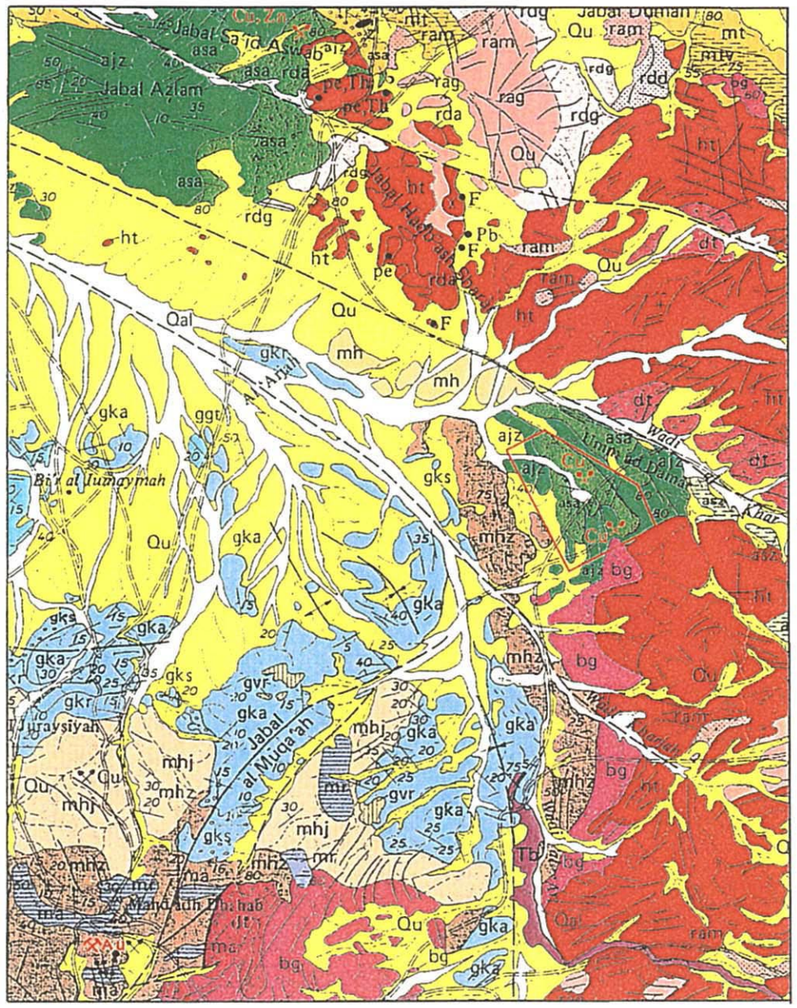
The Arj Group is the lowermost unit of this area, and the base of this Group is not known. The Arj Group in this area consists of Sayid Formation (asa in Fig. 1-2) composed of silicic volcanic rocks, Jabal Azlam Formation (ajz) composed of pyroclastic rocks and andesite, and undifferentiated rocks (asz). The main component of Sayid Formation is dark gray to green massive silicic rocks accompanied by sedimentary rocks. The lower part of the Jabal Azlam Formation consists of basaltic to andesitic breccia-tuff breccia and andesite, and the upper part of this formation of breccia, sandstone, and conglomerate. This Group is unconformably overlain by the Mahd Group.

The Mahd Group in this area consists of Tulaymisah and Haf Formations. Tulaymisah Formation is divided into pyroclastic rock unit (mtv) and volcanic rock unit (mt). Haf Formation is further divided into Juraysiyah Member (mhj), Zur Member (mhz), and undifferentiated rocks (mh). The Juraysiyah Member consists of basalt, andesite, and rhyodacite, while the Zur Member is composed of rhyolite and sedimentary rocks.

Ghamr Group in this area consists of Tuff Member (ggt) and Kharzah Formation. Kharzah Formation is further divided into mafic unit (gka), silicic unit (gkr), and sedimentary unit (gks).

Dhukhr Tonalite (dt) consists of gabbro – trondhjemite·granodiorite, and mostly of quartz diorite – tonalite. The relation between Dhukhr Tonalite and Arj Group is not clear. The age of the tonalite was measured by U-Pb (zircon) method and is reported to be 816±4 Ma.

The composition of the Fufayriyah Tonalite (ht, 760±10 Ma) is that of quartz diorite – tonalite.



AGE		SEDIMENTARY, VOLCANIC AND METAMORPHIC ROCKS		INTRUSIVE ROCKS
CENOZOIC	QUATERNARY	WADI ALLUVIUM	Qal	sand, gravel
		OLDER WADI DEPOSITS, FANS, TERRACES	Qu	SCREE(Qu)
	TERTIARY	BASALT	Tb	
UNCONFORMITY				
PROTEROZOIC		RAGHIYAH SUITE	rda	Dayahin Granite(582±26Ma): porphyritic
			rag	Assharah Granite: monzogranite(rag, 573±22Ma&575±28Ma), red granite and microgranite(ram)
			ram	
			rdg	Dumah Granodiorite: granodiorite(rdg), quartz monzodiorite(rdd)
			rdd	
		SUBVOLCANIC ROCKS	gvr	Rhyolite to rhyodacite
		GHAMR GROUP	ggt	tuffaceous member
			gka	Kharzah Formation: mafic units(gka), silicic units(gkr), sedimentary units(gks)
			gks	
			gkr	
UNCONFORMITY				
		BARI GRANODIORITE	bg	
		HUFAYRIYAH TONALITE	ht	tonalite(760±10Ma)
		SUBVOLCANIC ROCKS	mr	rhyolite to rhyodacite
			ma	basalt to andesite
		MAHD GROUP	mtv	Tulaymisah Formation: volcaniclastic rocks(mt) with vocanic units(mtv)
			mt	
			mh	Haf Formation: undifferentiated(mh), Juraysiyah Member(mhj)-basalt, andesite, rhyodacite, Zur Member(mhz)-rhyolite, sedimentary rocks
			mhj	
			mhz	
UNCONFORMITY				
		DHUKHR TONALITE	dt	tonalite(816±4Ma)
		ARJ GROUP	asz	Undifferentiated Sayid and or /Jabal Azlam Formations
			ajz	Jabal Azlam Formation: volcaniclastic rocks, andesite
			asa	Sayid Formation: silicic volcanic rocks

Fig.1-2 Regional Geology of the Survey Area

Bari Granodiorite (bg) intruded into the Mahd Group, and the latter is contact metamorphosed. The Granodiorite is covered by unmetamorphosed Ghamr Group. The composition of the Bari Granodiorite is the same as that of tonalite – trondhjemite.

Raghiyah Suite is divided into Dayahin Granite (rda, 582±26 Ma), Assharah Granite, and Dumah Granodiorite. Assharah Granite is further divided into monzogranite (rag, 573±22 Ma and 575±28 Ma) and red granite – microgranite (ram). Dumah Granodiorite is divided into granodiorite (rdg), and quartz monzodiorite (rdd).

Of the above geologic units, Sayid and Jabal Azlam Formations of the Arj Group occur in the survey area.

In this area, the distribution of the Arj Group is limited to near the Jabal Sayid deposit and in the survey area. The Group in the survey area has triangular distribution, and it is bounded; to the northeast by NW-SE trending Wadi al Aqiq strike-slip fault, to the south by Bari Granodiorite and Dhukhr Tonalite, and to the west by the Mahd Group.

3-1-2 Mineralization

The Jabal Sayid deposit occurs about 20-km northwest and the Mahd adh Dhahab mine is about 25-km southwest of the survey area.

The Jabal Sayid deposit is a stratabound massive sulfide deposit consisting of four orebodies. It is accompanied by a stockwork orebody below. The orebodies occur in the upper part of the silicic rocks of the Sayid Formation. These are overlain by chemically precipitated chert – carbonate formation. The sulfide minerals constituting the massive sulfide orebodies are mainly; pyrite, pyrrhotite, sphalerite, and chalcopyrite. The sulfides of the stockwork body are mainly pyrite and chalcopyrite with smaller amount of sphalerite. The pyroclastic rocks, the host of the stockwork body, are chloritized. The results of the feasibility study carried out by BRGM in 1985 show the combined reserves of Orebodies No.1 and No.2 to be 19.93 million tons (Cu 2.68 %).

Mahd ad Dhahab mine has been mined since ancient times (3,000 BP), and it is still being mined underground. The mineralization, which formed the deposit of this mine, was a vein-type Au-Ag-Cu-Zn hydrothermal activity. The age of this mineralization is 649 Ma. The

deposit occurs in andesitic tuff, andesite, agglomerate, and sandstone of the Haf Formation. The main ore minerals are; chalcopyrite, galena, sphalerite, and pyrite. The gangue minerals are quartz and chlorite. The host rock is silicified, chloritized, and potash-metasomatized. The ore reserves of the mine as of 1992 are 1.14 million tons (Au 31.8 g/t, Ag 167 g/t, Cu 0.87 %, Zn 3.24 %).

3-2 Geology and Mineralization of the Survey Area

3-2-1 Geology

Simplified geological map of the survey area is shown in Figure 1-3, and the map with scale of 1:10,000 is shown in Plate 1. The first-phase geological map was modified by geological data which were obtained from the second-phase detailed geological survey.

The geology of the survey area consists mainly of; rhyodacitic lava and pyroclastic rocks ("Ar" shown in Fig. 1-3), dacitic lava and pyroclastic rocks (Ad), breccia (Adb), andesitic lava and pyroclastic rocks (Aa), and jasper (Aj) belonging to the Late Proterozoic Arj Group. This group is intruded by diorite/ quartz diorite (D), tonalite (T), andesite/ porphyritic andesite (a), dacite/ porphyritic dacite (d), rhyodacite (r), and basalt/ porphyritic basalt (b) bodies. These units are covered unconformably by Late Proterozoic andesitic lava and pyroclastic rocks (Ha) of the Mahd Group in the western edge of the survey area. The rocks of the Arj Group are regionally chloritized and epidotized, and schistosity is partly developed.

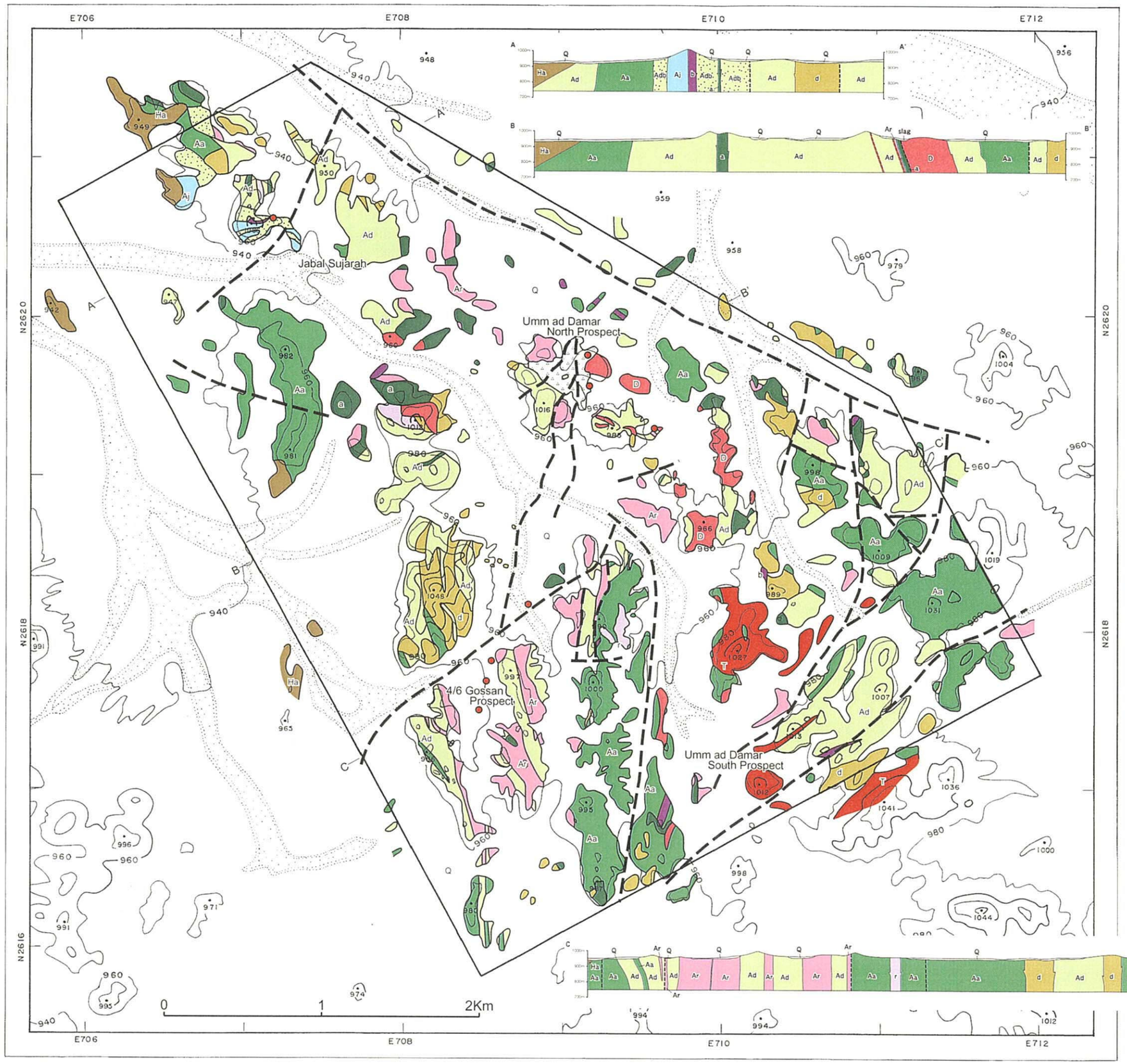
The strike of the Arj Group is NE at the South Prospect and the eastward, but it is NW – N in other parts of the survey area. The dip of the formations of this group is steeper than 60°. The attitude of the Mahd Group is NNW and 20 – 40° W.

NE-SW system faults are predominant in the survey area. The existence of a NW-SE fault, almost parallel to Wadi al Aqiq Fault is inferred in the northeasternmost part of the survey area.

3-2-2 Mineralization

From results of the first-phase geological survey, the past drilling exploration, and the second-phase drilling exploration, the existence of mineralization was confirmed in the four areas: Jabal Sujarah, the North Prospect, the South Prospect, and the 4/6 Gossan.

Volcanogenic massive sulfide-type Cu-Zn mineralization exists in Jabal Sujarah, the 4/6 Gossan,



AGE		SEDIMENTARY AND VOLCANIC ROCKS	INTRUSIVE ROCKS
CENOZOIC	QUATERNARY	Q Sand, Gravel	
LATE PROTEROZOIC	MAHD GROUP (Haf Foramtion)	Ha Andesite, Andesitic pyroclastic rocks, Conglomerate	
			BARI GRANODIORITE, HUFAYRIYA TONALITE: T Tonalite; D Quartz diorite, Diorite; b Basalt, Porphyritic basalt; a Andesite, Porphyritic andesite; d Dacite, Porphyritic dacite; r Rhyodacite
	ARJ GROUP (Jabal Azlam & Sayid Formations)	Aa Andesite,Andesitic pyroclastic rocks Ad Dacite, Dacitic pyroclastic rocks (Adb:Breccia) Ar Rhyodacite,Rhyodacitic pyroclastic rocks Aj Jasper	

Fault

MMAJ drill hole(1999)

Fig.1-3 Geological Map of the Survey Area

and a part of the North Prospect. On the other hand, vein-type Cu mineralization is confirmed in the North Prospect, and vein-type Au-Cu-Zn mineralization is in the South Prospect.

The ore minerals of all three prospects are oxidized to depths of 30—40 m and thus only gossan containing oxidized copper minerals, limonite, and hematite occur on the surface.

Mineralization at each areas is as follows.

(1) Jabal Sujarah

As feature of mineralization and alteration at the surface of this district, strongly carbonatized silicic breccia only crops out at the southwestern part of Mt. Sujarah, and ancient pits or gossans are not observed.

The mineralization catch by MJSU-8 is volcanogenic massive sulfide-type Cu-Zn mineralization. The interval between 73.25m and 85.85m is dominant with pyrite thin layers (amount of pyrite: approximately 20%), and contains two ore formations consisting of chalcopyrite, sphalerite and pyrite. The ore formations are less than 0.70m in thickness, and are interbedded with fine tuff and shale.

(2) North Prospect

A large amount of slag occurs at the North Prospect, and many ancient pits are distributed in the small hills to the west and southeast of this slag zone. The southeast hill is called "Southeast Hill" and the west hill was named "West Hill" during the present survey. Ancient workings are also distributed in the hills to the southeast of the Southeast Hill. The major geologic units near this prospect are rhyodacite and dacite of the Arj Group, and are elongated in the NW-SE direction. Diorite bodies have intruded into the Arj Group in the northeastern part of this prospect. Mineralization occurs only in the Arj Group and is not observed in the diorite bodies.

A total of five main mineralized zones are inferred to exist from the following observations; namely, the distribution of the ancient pits and gossan in trenches, and the results of drilling carried out in the past. The inferred five mineralized zones are; one in West Hill, another under the slag zone, one in Southeast Hill, and two in Southeast Extension. In this report, these zones will be numbered serially from No.1 to No.5 Mineralized Zones.

Regarding No. 1 Mineralized Zone, five holes have been drilled and DA-5 encountered ore zone of 2.6 m in width and Cu content of 2.17 %. For No.2 Mineralized Zone, drilling has not been carried out. On No.3 Mineralized Zone, four holes have been drilled and UAD-11 shows a zone of 3.1 m width and a grade of Cu 1.87 %. Drilling has not been carried out for No. 4 and 5 Mineralized Zones.

Eleven grab samples were collected on the surface of this prospect, but the gold content was low at Au 0.6 g/t maximum.

In the North Prospect, No.2 Mineralized Zone was confirmed by MJSU-4 and MJSU-5. This zone was inferred to occur below the slag distribution. The lower extension of No.1 Mineralized Zone was also confirmed simultaneously. These are both Cu vein mineralization with low content of Au and Ag.

In MJSU-5, low-grade Cu-Zn mineralization was observed at 268.90−275.40m interval, and this mineralization is considered to be volcanogenic sulfide from the texture of the ores. The host rocks of this mineralized zone is white rhyodacitic pyroclastic rocks which hosts the massive sulfide mineralization of the 4/6 Gossan.

(3) 4/6 Gossan

The geology of this prospect is composed mainly of rhyodacitic pyroclastic rocks with intercalation of basaltic tuff.

Two holes have been drilled here in 1983, and the mineralized zone encountered in UAD-14 is 2.1 m wide and contains Au 16.1 g/t, Ag 449.8 g/t, Cu 1.15 %, Pb 1.02 %. However this zone is secondary enrichment and the description of mineral assemblage and occurrence is not available. The grab samples collected in the trenches during the first-phase survey contain Au 3.7 g/t and Au 1.6 g/t.

It was clarified by the second-phase drilling that the mineralization of this prospect was divided into volcanogenic massive sulfide Cu-Zn mineralization and vein-type Cu-Ag mineralization, and the latter type is of small.

The volcanogenic massive sulfide Cu-Zn mineralization occurs both immediately above and below basaltic tuff. In MJSU-2 at 121.15−142.25m interval, the mineralized zone occur at a

horizon higher than the tuff, while it occurs below at 134.75－138.00m depth of MJSU-6.

During the first year of this project, the mineralization of the 4/6 Gossan was thought to be, from study of existing data and surface survey, only one epigenetic dissemination or network in the shear zones of Arj Group. But it is evident that it is volcanogenic massive sulfide and is syngenetic.

(4) South Prospect

The major geologic units near this prospect are rhyodacite, andesite, andesitic tuff, and dacitic tuff.

Seventeen ancient pits are confirmed in this prospect. The number of the main mineralized zone of this prospect is inferred to be one, from the distribution of ancient pits containing oxidized-copper minerals and gossan in trenches. Eleven holes including UAD-4 have been drilled for this mineralized zone, and ore zone encountered in UAD-2 is 6.9 m wide and Cu 1.99 %. However Au grades of mineralized parts of cores are not known. Two grab samples collected at the surface during the first-phase survey contain Au 6.2 g/t and Au 3.0 g/t. Thus this Cu mineralization is believed to be accompanied by Au contrary to that of the North Prospect.

In this phase, investigation of cores of UAD-4, which are stocked at Jabal Sayid Camp, was carried out. As results, a chalcopyrite-pyrite-quartz vein and a pyrite-chalcopyrite-sphalerite disseminated part were confirmed at the depths between 105.95m and 112.05m, and 112.05m and 115.00m, respectively. These mineralized parts were collected for ore assay, and the assay results are as follows.

Drill Hole No.	Drilling Depth (m)	Interval (m)	Assay Result			
			Au (g/t)	Ag (g/t)	Cu (%)	Zn (%)
UAD-4	105.95－112.05	6.10	0.34	22.9	1.97	0.23
	112.05－115.00	2.95	1.14	39.2	3.72	3.07

Contrary to the North Prospect, the mineralization of this prospect contains gold and zinc.

From the results of core investigation and ore assay, the mineralization of this prospect is inferred to be a vein-type Au-Cu-Zn mineralization.

CHAPTER 4 DISCUSSION ON THE RESULTS OF THE SECOND PHASE SURVEY

4-1 Geologic Structure and Mineralization Characteristics

The distribution of rhyolitic dacite and its pyroclastic rocks, diorite, and tonalite is shown in Figure 1-4.

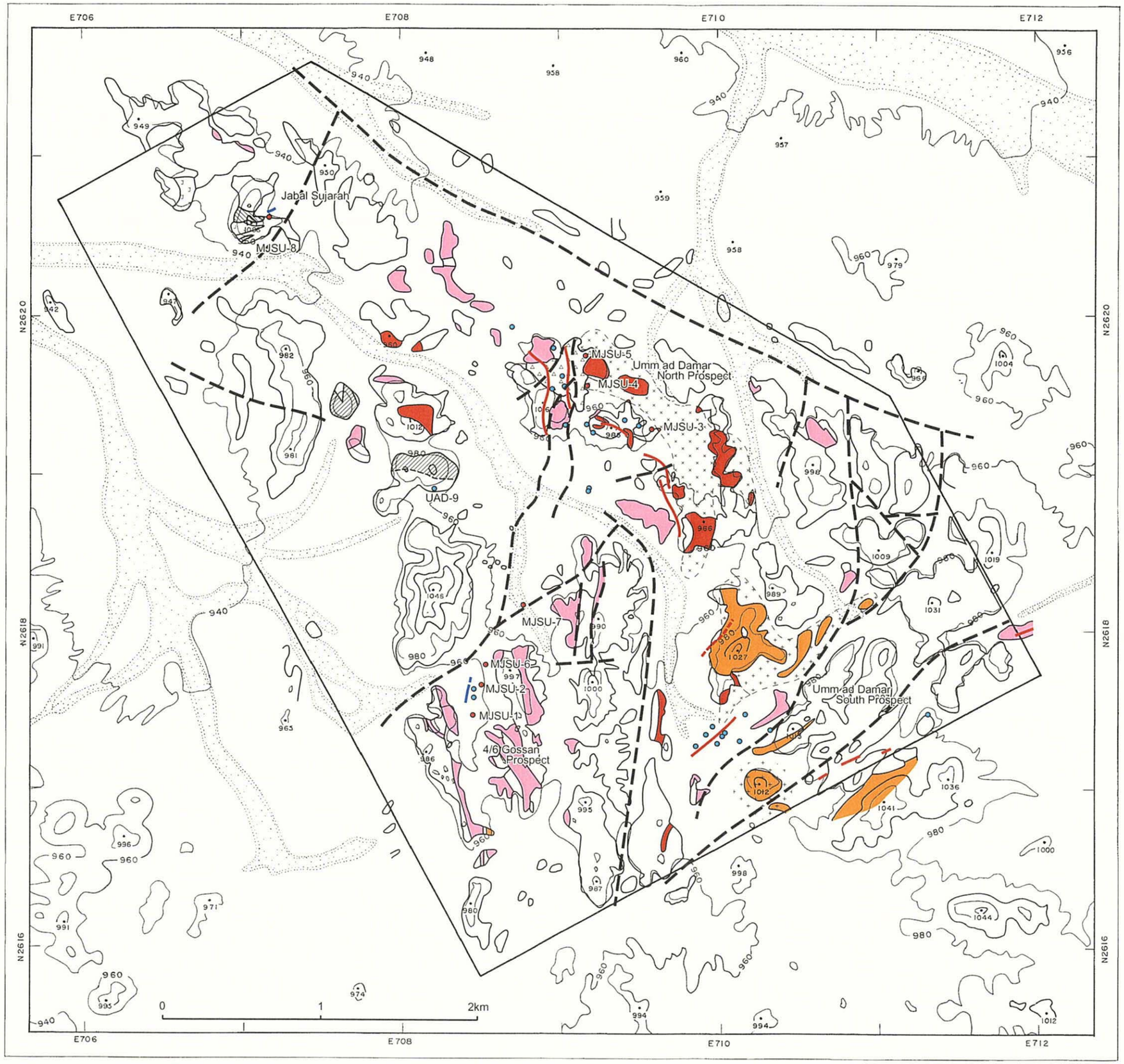
Existence of volcanogenic massive sulfide-type Cu-Zn mineralization, vein-type Cu mineralization, and vein-type Au-Cu-Zn mineralization was clearly demonstrated in the survey area by the drilling survey of the present phase and examination of old existing cores.

The vein-type Cu mineralization distributed in the North Prospect. It occurs as chalcopyrite-pyrite network veins in the fractured zones of dacitic pyroclastic rocks, porphyritic dacite (intrusive), and rhyodacitic pyroclastic rocks at the western periphery of a diorite body. Au, Ag grades are low. The vein-type Au-Cu-Zn mineralization is distributed in the South Prospect and occurs as chalcopyrite-pyrite-quartz veins and as chalcopyrite-pyrite-sphalerite dissemination in rhyodacitic pyroclastic rocks at the southwestern periphery of a tonalite-diorite body. The latter mineralization contains 1.14g/t Au. Both mineralization is distributed near plutonic rock bodies and thus the igneous activity associated with mineralization is considered to be tonalite and diorite intrusion.

On the other hand, promising volcanogenic massive sulfide-type mineralization is observed at the 4/6 Gossan where rhyodacitic pyroclastic rocks are developed and thus this mineralization is believed to be related to rhyodacitic volcanic activity. The massive ores and breccia ores of this mineralized zone alternate with shale and fine tuff, and thus are believed to have deposited during the pauses of volcanic activity. The volcanogenic massive sulfide-type Cu-Zn mineralization confirmed by MJSU-8 at Jabal Sujarah occurs at the boundary between breccia consisting of strongly silicified felsic volcanic rocks and rhyodacitic pyroclastic rocks. Thus the nature of this mineralization and that of the 4/6 Gossan is somewhat different.

4-2 Mineral Potential

An integrated analysis map is laid out in Figure 1-5. The mineralization of the survey area is divided into volcanogenic massive sulfide-type Cu-Zn mineralization, vein-type Cu mineralization, and vein-type Au-Cu-Zn mineralization. Of these, the Cu veins have low Au, Ag grade and cannot



- Arj Group rhyodacite,rhyodacitic pyroclastic rocks
- Arj Group jasper
- Diorite
- Tonalite
- Slag
- Fault
- Carbonatization
- Silicification
- Vein-type mineralization
- Massive sulfide-type Mineralization
- Previous drill hole
- MMAJ drill hole (1999)

Fig.1-4 Mineralization Map of the Survey Area

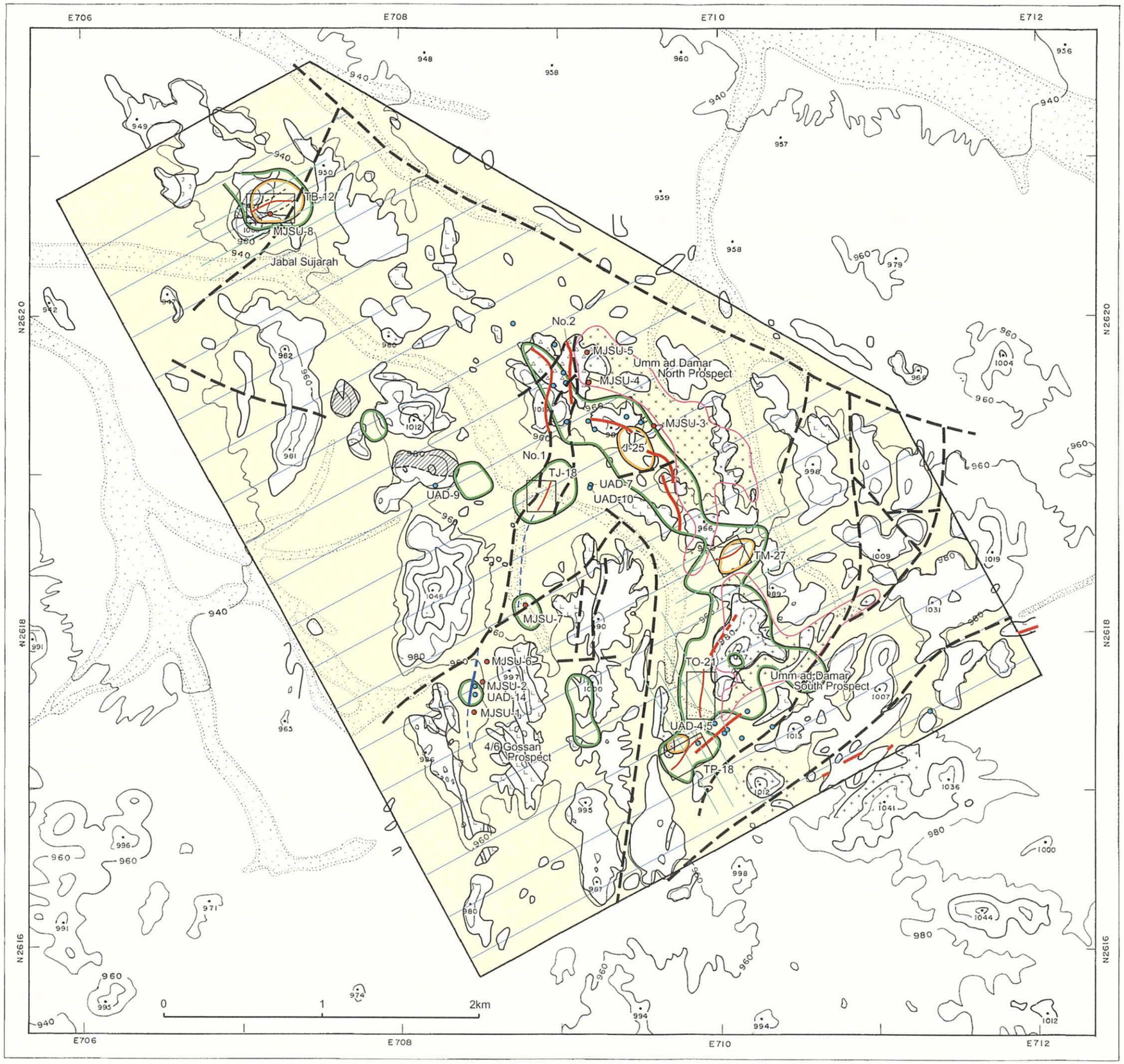


Fig.1-5 Integrated Interpretation Map

be mined. The following is the mineral potential of the survey areas on the basis of the results of drilling and geophysical exploration carried out this year.

4-2-1 Results of drilling exploration

(1) North Prospect

In this Prospect, MJSU-4 and MJSU-5 confirmed No. 2 Mineralized Zone and the lower extension of No. 1 Mineralized Zone below the slag zone. Both No. 1 and No.2 zones are of vein-type Cu mineralization, and the Au, Ag contents are low. In MJSU-5 low-grade Cu-Zn mineralization with ore texture similar to volcanogenic massive sulfides was observed at 268.90－275.40m interval. MJSU-3 drilled toward the center of "J-25" anomaly encountered only a small-scale vein-type Cu mineralization at 188.20－220.90m depth. This Prospect is thus considered to have a low potential for discovering minable mineral deposits.

(2) 4/6 Gossan and the vicinity

Four holes MJSU-1, MJSU-2, MJSU-6, and MJSU-7 were drilled this fiscal year in this Prospect and the vicinity. Evidence of strong mineralization was confirmed only at 121.15－142.25m interval of MJSU-2. The massive sulfide mineralized zone, which was confirmed in this hole, becomes very thin in MJSU-1 and MJSU-6. Therefore its lateral extension is inferred to be weak.

The orebody with true width of 2.1m near 45m depth (UAD-14) becomes two orebodies of 3.0 and 8.6m in true width between 100m and 120m depths (MJSU-2) indicating the possibility of extension below those confirmed in MJSU-2.

4-2-2 Results of geophysical survey

(1) TB-12 sub-area

In MJSU-8, chalcopyrite and sphalerite breccia ores were found at 73.25－73.55m depth and also pyrite-chalcopyrite massive ore at 82.65－83.35m depth. But the amount of pyrite decreased in the deeper zones and the drilling was ceased at 250.00m depth. Results of TEM survey was obtained after completion of the drilling and the extracted plate occur 30m north of the bottom of MJSU-8. Thus the possibility of the existence of a mineralized zone different form those confirmed by MJSU-8 is high.

(2) TJ-18 sub-area

TEM survey resulted in the extraction of three NE-SW extending vertical conductive plates. There is a small ancient pit near the central plate and hematitized rhyodacite is observed.

UAD-7 and UAD-10 holes drilled by SEREM/US Steel in 1977 are located 300m east of this pit. The cores of UAD-10 show that the geology of this hole consists of rhyodacitic pyroclastic rocks. And these rocks probably are distributed in this sub-area. Occurrence of volcanogenic massive sulfide-type Cu-Zn mineralization is highly possible in TJ-18.

(3) TM-27 sub-area

TEM survey resulted in the extraction of two NE-SW extending vertical conductive plates and the northern plate is located at the central part of chargeability anomaly. Rhyodacitic pyroclastic rocks do not occur at the periphery of this sub-area, and the northern plate is inferred to reflect vein-type mineralization. Judging from the strength of the conductivity, it is highly possible that the northern plate is sulfide-rich vein.

(4) TO-21 sub-area

TEM survey resulted in the extraction of a N-S extending vertical conductive plate under Quaternary sand and gravel bed. This plate is located at the central part of chargeability anomaly. To the northeast of this plate, chalcopyrite-bearing quartz-calcite vein has been traced for 325m. Judging from the location of this plate and the strength of the conductivity, this plate is inferred to reflect vein-type mineralization and to continue to the quartz-calcite vein.

(5) TP-18 sub-area

TEM survey resulted in the extraction of NE-SW extending two vertical conductive plates. UAD-4 and UAD-5 drilled by SEREM/US Steel in 1977 locate in the eastern margin of this sub-area. UAD-4 encountered vein-type Au-Cu-Zn mineralized zones at 105.95—115.00m.

Of these plates, the southern conductive plate TP-18B is located at the southwestern extension of the mineralized zone which extends in the NE-SW direction from the ancient pits of the South Prospect through UAD-4. Thus TP-18B is considered to reflect the existence of vein-type Au-Cu-Zn mineralization.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

Drilling, detailed geological survey, IP and TEM geophysical survey were carried out in the Umm ad Damar area during the second year of the project. The results are summarized as follows.

① At total of eight holes with total length of 2,152m were drilled. The drilling sites were selected from the results of the first-phase detailed geological survey on known prospects and of IP reconnaissance with 300m traverse interval.

② Drilling clarified the existence of volcanogenic massive sulfide Cu-Zn mineralization at Jabal Sujarah, 4/6 Gossan, and a part of the North Prospect, also Cu vein mineralization was found to occur at the North Prospect.

③ Volcanogenic massive sulfide mineralization was confirmed at MJSU-2, MJSU-5, MJSU-6, and MJSU-8. In these holes, massive ore and breccia ore consisting of chalcopyrite-sphalerite-pyrite occur in host rock of rhyodacitic pyroclastic rocks. Shale and tuff are intercalated in the mineralized zones. Alteration of the host rock is silicification and chloritization. The main mineralized zones are as follows.

Drill Hole No.	Drilling Depth (m)	Interval (m)	Assay Result			
			Au (g/t)	Ag (g/t)	Cu (%)	Zn(%)
MJSU-2	121.15—125.40	4.25	0.37	23.0	0.96	2.17
	130.10—142.25	12.15	0.37	14.0	1.00	3.67
MJSU-5	268.90—275.40	6.50	<0.05	2.1	0.99	0.20
MJSU-6	134.75—138.00	3.25	<0.05	28.0	0.69	3.84
MJSU-8	73.25—73.55	0.30	<0.05	3.9	0.90	12.74
	82.65—83.35	0.70	0.24	19.5	1.57	0.01

④ Cu vein mineralization was confirmed at MJSU-3, MJSU-4, and MJSU-5 of the North Prospect. The veins and network mineralization observed in these holes consist of chalcopyrite and pyrite. The host rocks are dacite and dacitic pyroclastic rocks. The veins and network contain little silicate and oxide minerals. Chloritization is notable near the veins. Gold and silver grade is low. The main mineralized zones are as follows.

Drill Hole No.	Drilling Depth (m)	Interval (m)	Assay Result			
			Au (g/t)	Ag (g/t)	Cu (%)	Zn (%)
MJSU-3	220.10—220.90	0.80	<0.05	6.6	2.48	0.03
MJSU-4	140.50—147.80	7.30	<0.05	9.1	1.98	0.03
	155.50—158.85	3.35	<0.05	6.3	2.19	0.07
MJSU-5	79.40—82.55	3.15	0.07	15.4	2.25	0.06
	88.90—93.20	4.30	<0.05	13.7	1.93	0.03
	95.50—99.90	4.40	0.06	12.5	3.70	0.02
	245.65—247.70	2.05	<0.05	2.0	1.02	0.02
	328.90—331.20	2.30	0.07	7.1	6.51	0.01

⑤ The cores (drilled in 1977) stored in Jabal Sayid camp were re-arranged. And UAD-3, UAD-4, UAD-6, and UAD-10 cores were examined. Chalcopyrite-pyrite-quartz veins were observed at 105.95—112.05m depth and pyrite-chalcopyrite-sphalerite dissemination at 112.05—115.00m depth of UAD-4 of the South Prospect. The host rocks were chloritized rocks. The results of assay are as follows.

Drill Hole No.	Drilling Depth (m)	Interval (m)	Assay Result			
			Au (g/t)	Ag (g/t)	Cu (%)	Zn (%)
UAD-4	105.95—112.05	6.10	0.34	22.9	1.97	0.23
	112.05—115.00	2.95	1.14	39.2	3.72	3.07

Ore samples collected from ancient pits of this Prospect also showed 3.0—6.2 g/t Au. It is seen that the mineralization of this Prospect has higher Au and Zn content than the Cu veins of the North Prospect.

⑥ IP geophysical survey was carried out in order to clarify the detailed chargeability distribution of the "B-12", "M-27", and "P-18" anomalous zones extracted by IP survey last year. The following was clarified as a result.

B-12 anomaly: The lateral extension of this anomalous zone is the largest in the survey area, and the chargeability is very high.

M-27 anomaly: This anomalous zone consists of northern and southern sub-zones. The northern strong anomaly sub-zone including station M-27 is oblong and extends in the NE-SW direction. The southern sub-zone occurs around station N-25 and is small.

P-18 anomaly: This anomalous zone extends northward and connects with station O-21.

⑦ Five sub-areas were selected for TEM geophysical survey. They are TB-12, TJ-18, TM-27, TO-21, and TP-18. Selection was based on IP survey and detailed geology. TEM survey resulted in extracting almost vertical conductive plates in these sub-areas.

⑧ The results of detailed geological survey, drilling, examination of existing cores, IP survey, and TEM survey were interpreted comprehensively. The conductive plates extracted in TM-27, TO-21, and TP-18 sub-areas are assessed to indicate vein-type mineralization and the plates in TB-12 and TJ-18 sub-areas volcanogenic massive sulfide mineralization.

5-2 Recommendations for the Third-Phase Survey

The following work is recommended for the third year of this project.

① Further drilling is recommended for the 4/6 Gossan in order to confirm the downward extension of the mineralized zone confirmed at MJSU-2.

② Occurrence of a new mineralized zone is anticipated from TEM results at Jabal Sujarah aside from that confirmed by MJSU-8. Further drilling is recommended in order to assess the mineralization of this sub-area.

③ Drilling is recommended for assessing the conductive plates extracted by TEM survey at TJ-18, TM-28, TO-21, and TP-18.